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HEWLETT PACKARD COMPANY
P O BOX 272400, 3404 E. HARMONY ROAD
INTELLECTUAL PROPERTY ADMINISTRATION
FORT COLLINS, CO 80527-2400

EXAMINER	
MONDT, JOHANNES P	

ART UNIT	PAPER NUMBER
3663	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

JERRY.SHORMA@HP.COM
mkraft@hp.com
ipa.mail@hp.com

Office Action Summary	Application No.	Applicant(s)	
	10/763,353	HOFFMAN ET AL.	
	Examiner	Art Unit	
	JOHANNES P. MONDT	3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 February 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4,6-9,11,12,14,15,19,26,31-39,48,50,54,55,60 and 64* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4, 6-9, 11,12,14,15,19,26,31-39,48,50,54,55,60, and 64.* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Amendment filed 2/26/08 forms the basis for this Office Action. In said Amendment applicants substantially amended claims 50, 54, 55, 60, 64 and 65 through substantial amendments of independent claims 50 and 60. Comments on Remarks submitted with said Amendment are included below under “Response to Arguments”.

Claim Rejections - 35 USC § 102

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. ***Claims 4, 6-9, 11, 26, 31-36, 48 and 50, 54, 55, 60*** are rejected under 35 U.S.C. 102(e) as being anticipated by Carcia et al (US 2004/0127038 A1) (cited previously; IDS).

Carcia et al teach a semiconductor device (thin film transistor; see title), comprising: a source electrode (“Source”, Figure 3, also: inherent in thin film transistor); a drain electrode (“Drain”, Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the

stoichiometric formula Zn_2SnO_4 (namely: one of said “combinations”, especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode (“Gate” in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate) (Examiner note: only very few elementary oxides are listed of which combinations are disclosed to be included as well).

On claim 6 and 31: the limitation “substantially amorphous” is met by Carcia et al, because inherently sputtering creates substantially amorphous forms of zinc oxide based oxides, as witnessed for example by Henrichs (US 2003/0185266 A1) ([0046], not cited here other than for establishment of fact; and cited previously).

On claim 7: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claims 8-9: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of Zn_2SnO_4. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly, the finite dissociation constant of Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 11: The limitation “is adapted to be deposited using an RF sputtering process”, is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process

claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 26: the examiner takes official notice that the limitation defined by this claim is inherently met, by any thin film transistor by definition of its gate. The official notice has not been traversed, and accordingly the subject matter of it is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 32: source, drain and gate electrodes are fabricated so as to be at least partially transparent (see abstract).

On claims 33-34: the limitations of claims 8 and 9, and of claims 33 and 34 are met by virtue of the finite dissociation constant of a ternary zinc-tin-oxide compound. For the finiteness of said dissociation constant the examiner had previously taken official notice; in support examiner refers to Fang et al, Material research Bulletin, Volume 36

(2001), 1391-1397, in which a tendency of Zn2SnO4 towards ZnO at some temperature is disclosed (see page 1396, "4. Conclusion").

On claim 35: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 36: The limitation “is adapted to be deposited using an RF sputtering process”, is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not. In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 48: Carcia et al teach a display (their claim 16) comprising: a plurality of display elements configured to being capable to operate collectively to display images, wherein each of the display elements includes a semiconductor device configured to

control light emitted by the display element (namely: the transparent oxide semiconductor transistors; see their claim 16), the semiconductor device including: a source electrode ("Source", Figure 3, also: inherent in thin film transistor); a drain electrode ("Drain", Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said "combinations", especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate).

On claim 50: Carcia et al teach a semiconductor device (TFT), comprising:

a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen ([0010]); and a gate electrode by definition configured to permit application of an electric field to the channel (N.B.: only its capability to do so is patentable, and said capability is inherent in "gate" of a field effect transistor, hence also of "gate" of a thin film transistor.

On claim 54: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 55: the gate electrode in Carcia et al is physically separated from the channel by a dielectric material (SiO_2 in Figure 3, [0046]).

On claim 60: Carcia et al teach a thin film transistor (see “Summary of the Invention”), inherently comprising a gate electrode (see also Figure 3, “VgGate” indicating voltage to gate electrode underneath an n+ gate region), a channel layer (see also Figure 3, the region between source and drain abutting both) and dielectric material disposed between and separating the gate electrode and channel layer (see Figure 3, the region separating source, channel and drain from gate region and gate electrode); first and second electrodes spaced from each other and disposed adjacent the channel layer on a side opposite the dielectric material, such that the channel layer is disposed between and electrically separates the first and second electrodes. At least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said “combinations”, especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode (“Gate” in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate) (Examiner note: only very few elementary oxides are listed of which combinations are disclosed to be included as well).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. ***Claim 19*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al (US 2004/0127038 A1) (cited previously, and IDS) in view of Taylor (4,521,698) (cited previously).

On claim 19: Carcia et al teach a three-port device (source, drain and gate being the three ports), comprising: a source electrode ("Source"; Figure 3); a drain electrode ("Drain"; cf. Figure 3); a gate electrode ("”Gate"; Figure 3); furthermore, in reference to the claim limitation "means for providing a channel configured to permit movement of electric charges there-through between the source electrode and the gate electrode, intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto , 136 USPQ 458, 459 (CCPA 1963).

In the underlying case, it is thus only parenthetically mentioned that indeed the prior art by Carcia et al teaches a means for providing channel disposed between the source electrode and the drain electrode (said means being a semiconducting oxide layer comprising zinc separating source and channel with a gate electrode sufficiently nearby to produce a channel when given a voltage that either accumulates, depletes or inverts the interface between the semiconducting oxide layer and a dielectric layer separating gate from semiconductor oxide layer; furthermore, channel is inherent in the thin film transistor by Carcia et al and is implied by the existence of a gate near a channel forming substance, as the ZnO

area in Figure 3), inherently permitting movement of electric charge there-through between source and drain in response to a voltage applied at the gate electrode, the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen, where the means for providing a channel includes means for providing a semiconductor formed from a zinc-tin oxide compound having the stoichiometry Zn_2SnO_4.

Also, the limitation “means for providing a semiconductor” (second line from below) constitutes a product-by-process limitation, because, while said channel comes about through a method of use (application of voltage to gate), the “means for providing a semiconductor is a limitation on how to make said semiconductor. The limitation is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

Carcia et al do not necessarily teach the limitation on movement of electric charge between source and gate electrode in response to voltage (lines 6-8). *However, it would have been obvious to include said limitation in view of Taylor, who, in a patent on insulated gate field effect transistors, namely MOSFETs*, hence related art, teach the use thereof wherein gate and drain are conductively connected so as to avoid hot electron effects (title, abstract, Figure 3; in particular transistor 224; and columns 1-3).

Motivation to include the teaching by Taylor at least derives from the generic undesirability of hot electron effects, i.e., effect whereby the acceleration of electrons due to the voltage head between source and drain leads to electron-electron collisions upon the impact on the drain region of accelerated electrons from the channel, resulting in the excitation of valence electrons into the conduction band, i.e., to electron-hole pair production, resulting, due to the relatively large effective mass of the holes, in unwanted further bias of the semiconductor region near the channel.

3. ***Claim 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al as applied to claim 50, in view of Hong et al (6,674,495 B1) (cited previously).

As detailed above, Carcia et al anticipate claim 50. Carcia et al do not necessarily teach the further limitation that the source and drain electrodes are formed from an indium-tin oxide material. However, it would have been obvious to include this further limitation in view of Hong et al, who, in a patent on a thin film transistor array panel for

display, hence analogous art (see title and abstract), teach the source and drain electrodes to be ITO (i.e., indium-tin oxide) electrodes (see column 20, lines 25-37, and e.g., Figures 1 and 23) in a patent in which ITO and zinc oxide are both respectively cited for conductivity and transparency, two important advantages for electrode material in a display (see, e.g., columns 9 and 20). Inherently, source and drain electrodes in any thin film transistor, in fact in any field effect transistor, are separate from one another. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416. Furthermore, the limitations “formed from” and “patterned” constitute product-by-process limitations and are only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

4. ***Claims 15 and 39*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al and Krivokapic et al as applied to claims 14 and 38, respectively, above, and further in view of Hornik et al (US 2004/0169210 A1) (cited previously).

As detailed above, claims 14 and 38 are unpatentable over Carcia et al in view of Krivokapic et al.

Neither Carcia et al nor Krivokapic et al necessarily teach the further limitation defined by claims 15 or 39, respectively.

However, it would have been obvious to include said further limitation in view of *Hornik et al,* who, in a patent on barrier material against the diffusion of hydrogen into a high dielectric constant layer such as PZT during passivation of gate oxide, teaches to protect said layer of PZT with a pair of Al_2O_3 layers with a TiO_2 layer in between (see [0006] and [0024]). *Because PZT is also included in the teaching by Krivokapic et al as one of the gate oxide materials, it would have been obvious* to include the teaching on hydrogen diffusion barrier structure against deterioration of PZT also in the gate oxide by Krivokapic et al. To protect the PZT layer optimally it would furthermore have been obvious to provide the $Al_2O_3/TiO_2/Al_2O_3$ layer on both sides of the PZT layer, thus meeting the claim limitation. *Motivation* to include the teaching by Hornik et al derives immediately from the increased integrity resulting from the protection of the PZT against a lowering of its dielectric constant due to hydrogen diffusion.

5. ***Claim 64*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Cillessen et al (5,744,864) (previously cited and made of record by applicant in IDS) and Ando et al (6,184,946 B1) (cited previously).

Carcia et al teach a semiconductor device including a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode; and a gate electrode configured to permit application of an electric field to the channel, all of the above inherent in the thin film transistor (TFT) by Carcia, and disclosed in Figure 3, Examples 1-7. Although the provisional application by Carcia et al does not disclose the limitation that the channel is formed of zinc-tin-oxide, it would have been obvious to include said limitation in view of Cillessen et al, who, in a patent on a semiconductor device with source, drain and insulated gate (see Figure 4 and col. 4, l. 27+), hence art analogous to Carcia et al, teach that the channel is formed of covalent oxide of a non-transition metal including ZnO , or SnO_2 or mixtures or compounds thereof (col. 5, l. 30-50). *The claim would have been obvious because* one of ordinary skill has good reason to pursue the known options within his or her technical grasp; if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Carcia et al do not necessarily teach the limitation that said semiconductor device is included in a display comprising a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a semiconductor device configured to control light emitted by the display element. *However, it would have been obvious to include said further limitation in view of Ando et

al, who, in a patent on thin film transistor based applications to display technology (title and abstract), hence analogous art, teach the application of thin film transistors (TFTs) (col. 4, l. 3-25), in particular as switching elements (abstract) used for switching in a method for controlling an active matrix display (title, abstract), wherein the TFT selectively controls activation and deactivation of a pixel of the active matrix display by selectively controlling the gate voltage (cols. 1-col. 2, l. 5: that is how thin film transistor function). *Motivation* to include the teaching by Ando et al in the invention by Carcia et al derives from the obvious advantage of applying a transparent and high mobility TFT such as taught by Carcia et al to said active matrix display because little light is lost by absorption by the thin film transistor (said semiconductor layer being transparent to light; Figure 7 and discussion) while the device speed is still high as witnessed by the excellent current-voltage characteristics (i.e., mobility) (see Figures 4-9).

9. ***Claims 4, 7-9, 12, 19, 26, 32-35, 37, 48, 50, 54, 55, 60 and 64*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al (5,744,864).

On claim 4: Cillessen et al teach a thin film transistor (see col. 1, l. 13) comprising (inherently) a source electrode and a drain electrode (2 and 3 or 3 and 2) (col. 4, l. 26-58 and abstract); a channel 4 (col. 4, l. 35 and abstract) coupled to the source and drain electrodes and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or

compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 19: Cillessen et al teach a three-port semiconductor device (thin film transistor; see col. 1, l. 5-18), comprising (inherently) a source electrode and a drain electrode, and a gate electrode (2, 3 and 5 or 3, 2 and 5: see abstract col. 4, l. 27+; Figure 4); and means for providing a channel 4 (col. 4, l. 35 and abstract) (Examiner note: said means for providing a channel in light of the specification, and conform 35 U.S.C. 112, sixth paragraph, identified as element 18 in said Specification, which is a channel region, within which by action of the gate a (narrow) channel is formed in the ON state), the means for providing a channel formed at least in part from a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4 is indeed a simple compound formed from ZnO and SnO2,

namely: $ZnO + SnO_2$. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 48: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising a plurality of display elements (loc. cit.) configured to operate collectively to display images (col. 3, l. 25-40), where each of the display elements includes a semiconductor device configured to control light emitted by the display element (being a switching element (see col. 1, l. 5+ and col. 2, l. 63 – col. 3, l. 40), the semiconductor device including: a source electrode and a drain electrode (2 and 3 or 3 and 2, resp.) (col. 4, l. 27-58 and abstract); a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferable a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly taught, is indeed a simple compound formed from ZnO and SnO2, namely: $ZnO + SnO_2$. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or

her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 50: Cillessen et al teach a semiconductor device (title), comprising: a source electrode and a drain electrode (2 and 3, or 3 and 2; see abstract and col. 4, l. 27-58); a channel 4 (abstract and col. 4, l. 27-58) coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43); an a gate electrode 5 (col. 4, l. 27+ and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide of the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary zinc-tin-oxide compound, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 60: Cillessen et al teach a thin-film transistor (col. 1, l. 5-12: see especially the reference to Japanese Patent Application 60-198861 as defining the kind of device to which the invention relates, which is a thin-film transistor), comprising: a gate electrode 5 (abstract and col. 4, l. 27-58); a channel layer 4 formed of a covalent oxide of a non-transition metal (col. 5, l. 30-50), preferably an oxide from Zn, Sn, In; a

dielectric material 6 disposed between and separating the gate electrode and the channel layer (Figure 4, abstract and col. 4, l. 27-58); and first and second electrodes 2 and 3 (abstract and col. 4, l. 27-58) spaced from each other and disposed adjacent the channel layer on a side of the channel layer 4 opposite the dielectric material 6 such that the channel layer is disposed between and electrically separates said first and second electrodes (Figure 4 and abstract).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a ternary zinc-tin-oxide material, including the compound Zn_2SnO_4 is indeed obtainable through rf magnetron sputtering with reasonable expectation of success, as either mixture or compound from ZnO and SnO_2. All ternary compounds that are combinations in the aforementioned manner are easily tested on mobility and hence their suitability as channel material. Furthermore, ternary compounds are the simplest of compounds that are combinations of any binary compounds. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 64: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising: a plurality of display elements configured to operate collectively to display images (loc.cit and col. 3, l. 25-40), where each of the display elements includes a

semiconductor device (their thin film transistor (col. 1, l. 5-12) as 'switching element'; see col. 3, l. 6) configured to control light emitted by the display element, the semiconductor element including: a source electrode and a drain electrode (2 and 3 or 3 and 2; abstract and col. 4, l. 27-58; see Figure 4) a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 5, l. 30-50); and a gate electrode 5 (abstract and col. 4, l. 27-58) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary compound containing zinc, tin and oxide, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claims 7, 32, 35 and 54: source, drain and gate electrodes are fabricated so as to be at least partially transparent (see abstract).

On claims 8-9 and 33-34: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of a ternary zinc-tin-oxide compound. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly,

the finite dissociation constant of, for instance, Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 12 and 37: the source and drain electrodes are formed from an indium-tin-oxide material (col. 7, l. 41 – col. 8, l. 39, especially col. 8, l. 29). The manner of fabrication is without patentable weight, being a product-by-process limitation; however, the manner of fabrication does include patterning the source/drain electrodes (loc.cit.), while the final result is their physical separation, without which the thin film transistor would not be operative (Figure 4).

On claim 55: the semiconductor device further comprises means for providing a dielectric 6 (abstract and col. 4, l. 27-58) (interpreted in light of the specification as dielectric medium 90) disposed between and physically separating the gate electrode from the means for providing a channel.

On claim 26: the limitation of this claim is simply inherent to all field effect transistors, including the thin film transistors. See also col. 6, l. 46+.

10. ***Claims 6, 11, 31 and 36*** rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al in view of Carcia et al (2004/0127038 A1) (cited previously). Although Cillessen et al do not necessarily teach the further limitations of these claims, it would have been obvious to use RF, in particular magnetron, sputtering in view of Carcia et al (see [0010]), inherently yielding a substantially amorphous material. The claim would have been obvious because the technique (RF sputtering of covalent oxides of non-transition metals) was part of the ordinary capabilities of a

person of ordinary skill in view of the technique for improvement in a very similar situation.

6. ***Claims 14 and 38*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Krivokapic et al (6,100,558) (cited previously).

As detailed above, Carcia et al anticipate claims 55 and 60.

Carcia et al do not necessarily teach the limitation that said dielectric material is an aluminum-titanium oxide material. *However, it would have been obvious to include said limitation as witnessed, for instance, by Krivokapic et al,* teaching a combination of Al_2O_3 and TiO_2 for the gate dielectric layer the purpose of increasing the dielectric constant of the gate oxide (Figure 19 and column 8, lines 3-26) so as to overcome adverse effects of small defects or contamination of the gate oxide material (see "Background of the Invention", col. 1). *Motivation* to include the teaching by Krivokapic et al in the invention by Carcia et al derives from the consequent reduction in defective operation.

Response to Arguments

1. Applicant's arguments filed as "Remarks" with said Amendment filed 2/26/08 have been fully considered but they are not persuasive.

In particular:

<u>On "Claim Rejections under 35 U.S.C. 102:</u>

Applicant's argument that the combination of two ZnO molecules with one SnO_2 molecule does not meet the anticipated "combinations" of inter alia ZnO and SnO_2 as

disclosed in Carcia (par. [0010]) and that Carcia “fails to teach the use of a ternary compound” (page 13) does not persuade, because (a) 2ZnO + SnO_2 is a combination of ZnO and SnO_2, (b) the number of such combinations is very small indeed, inherently so because of the limited bonding possibility for forming compounds.

With regard to the request for clarification of the rejection of claim 50 (pages 13-14), apparently the necessarily integer ratios of atoms in any compound is unknown to applicant. The “non-stoichiometric compounds” referred to in applicant’s Remarks (page 14) are but mixtures of compounds while the claim language merely recites the channel to be “comprised of” the latter. The only compounds comprising ZnO and SnO_2 meet the claim limitation on j, and hence the claim limitation as amended is met by the prior art.

The recitation of ZnO and SnO_2 comprised in the disclosure of a list of four binary compounds and their combinations by Carcia is merely a compact manner of claiming a list of the compounds which applicant admits to be equivalent with the recitation (page 13). Said list does comprise Zn_2SnO_4.

Applicant’s argument that a “compound having the above stoichiometry could not be created from the simple mixture of the four binary compounds is in error, because any compound comprising ZnO and SnO_2 can be created therefrom, because both ZnO and SnO_2 are building blocks of said “non-stoichiometric compound”, as witnessed by the very chemical composition formula defining the latter. Even arguendo, the disclosed “combinations” by Carcia nor the claim language require the actual making from ZnO and SnO_2, merely the “combination” as actual composition as claimed.

Applicants' arguments appear to further suggest the claiming of non-stoichiometric compounds, while no such recitation is present in the claim language. Because j=1/2 and j=2/3 are in the range as claimed, both $ZnSnO_3$ and Zn_2SnO_4 meet the limitation.

On "Substantially Amorphous" (pages 14-17):

Applicant's arguments appear to confuse "essentially amorphous" and "substantially amorphous". "Substantially" renders the limitation very broad indeed. See MPEP 2073.05(b) and 2112.01. See also Playtex Products Inc. v. Proctor & Gamble Co. (73 USPQ2d 2010): the term "substantial" has been held to be a meaningful modifier implying "approximate" rather than "perfect", and hence "substantially amorphous" is to be interpreted as a comparative term or expression. Comparison requires a reference point. No such reference point has been provided in the Specification. In response to arguments on page 17 on an alleged teaching away by Carcia et al for disclosing "polycrystalline", said arguments fail to persuade because "substantially amorphous", according to the above reasoning held by the U.S. Court of Appeals, Fed. Circuit, cannot mean "perfectly amorphous", a distinction between "polycrystalline" and "substantially amorphous" is at best one of degree, while said distinction of degree has not been delineated by the specification.

Furthermore, Applicant on page 16 misinterprets the evidentiary reference, Henrichs et al: Henrichs is not stating that normally an amorphous state results from ion sputtering, but instead states that ion sputtering "is normally used to epitaxially deposit dielectric amorphous materials", a phrase apparently cited by applicant without

comprehending that “normally” qualifies not the frequency of the result but instead only the frequency of selection of the method (see Henrichs, [0046]).

Therefore, Applicant’s arguments with regard to “Substantially amorphous” fail to persuade.

That Carcia et al disclose also additionally other methods (page 16) has no relevance to the issues at hand, because Carcia et al disclose sputtering, while the results obtained by sputtering are cited.

On “Phase-Segregated”:

Apparently, applicant considers any statement of official notice on the mere finiteness of the value of a dissociation constant of a compound “esoteric”. However, said finiteness, when untrue, would result in the impossibility to dissociate the compound no matter how much energy would be available to cause said dissociation. Confirmation of the finiteness of said dissociation constant is the coexistence of a tendency from Zn_2SnO_4 to yield ZnO at a finite temperature, as witnessed, for instance by Fang et al (Materials Res. Bull. 36 (2001), pp. 1391-1397, e.g. page 1396, “Conclusion”. Applicant’s protestation that a previous action had a different official notice regarding the finiteness of the dissociation energy of $ZnSnO_3$ is not persuasive: obviously both are finite, and the official notice pertains to a different aspect of the claim language. Applicant’s traverse based on the esoteric nature of the technology (page 19) is not persuasive either: there is nothing esoteric about formation and dissociation of chemical compounds involving Zn, Sn and O, nor is there anything esoteric about the concept of dissociation energy. Also, applicant cannot call the official notice

unsubstantiated at this moment; he can only challenge the official notice, and the evidence in terms of Fang et al is herewith presented to meet the challenge.

On Claim Rejections under 35 USC 103(a):

(a) Claims 19, 21, 22 and 24:

On page 21, applicant essentially presents an argument for the second time (see Remarks on page 12): Applicant's argument that the combination of two ZnO molecules with one SnO_2 molecule does not meet the anticipated "combinations" of inter alia ZnO and SnO_2 as disclosed in Carcia (par. [0010]) and that Carcia "fails to teach the use of a ternary compound" (page 13) does not persuade, because (a) 2ZnO + SnO_2 is a combination of ZnO and SnO_2, (b) the number of such combinations is very small indeed, inherently so because of the limited bonding possibility for forming compounds.

With regard to the request for clarification of the rejection of claim 50 (pages 13-14), apparently the necessarily integer ratios of atoms in any compound is unknown to applicant. The "non-stoichiometric compounds" referred to in applicant's Remarks (page 14) are but mixtures of compounds while the claim language merely recites the channel to be "comprised of" the latter. The only compounds comprising ZnO and SnO_2 meet the claim limitation on j, and hence the claim limitation as amended is met by the prior art.

The recitation of ZnO and SnO_2 comprised in the disclosure of a list of four binary compounds and their combinations by Carcia is merely a compact manner of claiming a list of the compounds which applicant admits to be equivalent with the recitation (page 13). Said list does comprise Zn_2SnO_4.

(b) Claim 12:

No independent, additional argument is presented on page 22.

(c) Claims 14 and 38:

No independent, additional argument is presented under this heading on page 22.

(d) Claims 15 and 39:

No independent, additional argument is presented under this heading on page 23.

(e) Claim 60:

Applicant's argument in traverse (pages 24-25) is in part obsolete by the current amendment, which requires the compound Zn_2SnO_4, while with regard to said currently recited compound, arguments have already been addressed overhead.

Again, under "Improper and Inaccurate Motivation for Proposed Combination", applicant again alleges no motivation; however, a few compounds, as disclosed by Carcia, do not form a prohibitive number of compounds, as alleged by applicant. Moreover, whether of a given compound, one or two molecules combine with a given other compound is entirely predetermined by valence. Therefore, argument by applicant are not persuasive.

On "Unexpected Experimental Results"

Applicant does state (Specification, lines 27-31) that "experimental results revealing a high degree of charge mobility in the present ternary channel material were unexpected. Even more unexpected were findings showing adequate charge mobility in

certain amorphous zinc-tin-oxides." However, applicant provides no experimental data, let alone a comparison with the prior art findings within the context of which it may become clear in comparison with which previous findings the result for the mobility of Zn_2SnO_4 and of amorphous zinc-tin-oxides may indeed be called unexpected. Counter to what is usually done in the scientific research community, especially through refereed journal articles, and counter to what is done in patent applications in which unexpected results are substantiated, no quantitative evaluation of any kind is included in the Specification.

The following question naturally arise with respect to the aforementioned quote from the Specification:

In comparison with which material are the aforementioned mobilities unexpectedly high? Are they unexpectedly high in terms of the previous findings on mobility of Zn_2SnO_4 as found, for instance, by Young et al, in "Growth and Characterization of radio frequency magnetron sputter-deposited zinc stannate, Zn_2SnO_4, thin films", Journal of Applied Physics, Volume 92, Number 1, 1 July 2002, which specifically present detailed experimental data on transport properties of Zn_2SnO_4 in section V (pages 314-318) and cite an electron mobilities < 27 cm^2 / (V.s). It is noted, however, that remarkably low values for the effective mass are also provided. Clearly, any claim of unexpected results should have made on the basis of a comprehensive experimental, comparative evaluation on electron mobility regarding the relevant literature.

No independent, additional arguments are presented regarding the rejections of claim 64, claims 4, 7-9, 12, 19, 26, 32-35, 37, 48, 50, 54, 55, 60, and 64, and claims 6, 11, 31, and 36.

In view of the above, applicants arguments fail to persuade.

Conclusion

2. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOHANNES P. MONDT whose telephone number is (571)272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Johannes P Mondt/
Primary Examiner, Art Unit 3663